

SESSION XIII
P² SUCCESS STORIES

SESSION CHAIRPERSONS:

Ms. Deneise DeHoyos, HQ AFCEE/EQT
Mr. Jay Williams, Roy F. Weston, Inc.

Compliance Through P2: A Success Story

US Navy Shipboard Solid Waste Management Program

James J. Coyle, Principal Associate, TAMS Consultants, Inc.
655 Third Ave., New York, NY 10017, 212-867-1777, jcoyle@tamsconsultants.com

Anthony Nickens, Environmental Protection Research, Development, Test and Evaluation Program Manager, Department of the Navy, Naval Sea Systems Command
Att'n NAVSEA Code 03R16, 2531 Jefferson Davis Highway, Arlington, VA 22242-5160
703-602-0706, nickens_anthony@hq.navsea.navy.mil

Robert K. Ostermueller, Northern Division, Naval Facilities Engineering Command
Department of the Navy, Northern Division, 10 Industrial Highway, Mail Stop #82
Lester, PA 19113-2090, 610-595-0759

1.0 Background

The United States is a party to the 1973 International Convention on Prevention of Pollution from Ships. The 1973 Convention was amended to the MARPOL Protocol in 1978, and the combination is frequently referred to as MARPOL 73/78. Annex V of MARPOL 73/78, which pertains to shipboard solid waste disposal at sea, protects the ocean environment by prohibiting some discharges altogether (e.g., plastics), restricting some discharges to particular distances from land, and establishing "special areas" within which additional discharges limitations apply.

These "special areas" of water are so designated because their oceanographic characteristics and ecological significance require protective measures more strict than other areas of the ocean. Three areas are currently in effect for strict enforcement of particular regulations, and five areas are designated, but not yet in effect. The three areas in effect are the Baltic Sea, portions of the North Sea, and the Antarctic Ocean. The five areas designated, but not in effect, are the Red Sea, Black Sea, the Gulfs area (including the Persian Gulf and Gulf of Aden), the wider Caribbean (including the Gulf of Mexico), and the Mediterranean Sea.

The international community has long recognized that the physical and operational characteristics of warships pose special problems for strict compliance with MARPOL 73/78, which reasonably focuses on civilian vessels that are far more prevalent than warships on the world's oceans. Article 3 of MARPOL 73/78 recognizes the special nature of warships by not requiring strict compliance with the provisions of the Convention because of special considerations of mission effectiveness and operational flexibility.

MARPOL 73/78 was implemented for the United States in the Act to Prevent Pollution from Ships, or APPS, but with compliance requirements for warships. Annex V has been implemented in the United States by amendments to APPS and Section 1003 of the National Defense Authorization Act for Fiscal Year 1994 (DAA-94). Under DAA-94, Navy ships are required to come into full compliance with MARPOL Annex V or the Navy must notify Congress. As required by the DAA-94 for special areas,

- surface ships must eliminate all discharges of plastic by December 31, 1998;
- surface ships must comply with limits on discharges of other solid waste in special areas that are "in effect" by December 31, 2000.
- submarines must comply with both requirements by December 31, 2008.

2.0 Past Navy Compliance Efforts

Since the early 1980s, as part of its overall view toward pollution prevention, the Navy has been developing means to eliminate or mitigate discharge of solid waste from its ships. Through a combination of material substitution, source reduction, environmental education and management practices (such as the institution of the 3 day/20 day plastics rule, which deals with on-board retention of plastics), the discharge of plastic waste has been cut by over 70 percent. The Navy is continuing its efforts to reduce the amount of plastics brought on board.

The Navy has also pursued development of other technologies to help manage plastic solid waste at sea. This new Navy developed technology, which is now being procured and installed, will allow Navy surface ships to expand prevention pollution efforts by coming into full compliance with restrictions on discharge of plastic waste. The new technology that was developed is an on board plastics processor that compresses and sanitizes plastic waste for storage on board and retrograde. Funding for plastics processors is in place for completion of installation by the end of 1998.

The other Navy shipboard solid waste streams include biodegradable wastes, such as food, paper, and cardboard, and non-biodegradable wastes such as metals and glass. Current practices for the discharge of other solid waste are set forth in Chief of Naval Operations Instruction (OPNAVINST) 5090.1B. These practices include establishing minimum distances from land, and specifying the forms in which various types of solid waste can be discharged at sea. In addition, some vessels contain on board processing and destruction systems such as compactors and incinerators to help manage their waste.

3.0 Special Areas Compliance Plan

Recognizing the difficulty in achieving strict compliance with all requirements of Annex V, DAA-94 required the Navy to prepare a plan for compliance with the special area requirements of Annex V Regulation 5. The special area compliance plan was submitted to Congress in November 1996.

Critical factors in developing a shipboard solid waste management strategy include the composition, operation, and deployment of the US Naval fleet, waste generation rates and characterization, and current Navy solid waste management policies and practices. A thorough understanding of the ramifications of these factors enabled the Navy to identify several potential solutions for managing its shipboard solid waste. In addition to source reduction, the three areas of opportunity identified were:

- Store and retrograde (store all waste and return to shore for land-based processing and/or disposal);
- Process and discharge at sea; and
- Destroy on-board.

Once the Navy analyzed the primary technology alternatives appropriate for use in managing solid waste generated aboard ship, the next step was to determine the impact of installing, operating, and maintaining the identified equipment on board the various ships in the fleet.

To assess and distinguish the advantages and disadvantages of each shipboard solid waste management option under consideration, the Navy established a series of evaluation criteria: operational impacts, safety/quality of life, physical ship impacts, extent of compliance with APPS, environmental consequences, technical maturity, and cost.

4.0 The EO 12114/NEPA Process

An Environmental Impact Statement (EIS) was prepared to assess the environmental impacts of compliance plan alternatives. This was done pursuant to Executive Order 12114 -- Environmental Effects Abroad of Major Federal Actions -- and Section 102(2)(c) of the National Environmental Policy Act (NEPA) of 1969, as implemented by the Council on Environmental Quality regulations, each of which establishes environmental review requirements for major federal actions. The provisions of Executive Order 12114 apply to major federal actions that occur beyond three nautical miles of the US, in the global commons, or within the jurisdiction of a foreign government. The provisions of NEPA apply to major federal actions that occur in the US and within three nautical miles from shore.

4.1 Scope of the EIS

Ships in the US Navy's fleet generate a variety of different waste streams, including solid waste, oily waste, hazardous waste, medical waste, sewage or "blackwater," and graywater (wastewater from sinks, showers, laundries, and galleys). These waste streams are regulated by law and are managed by Navy waste discharge restrictions as defined in OPNAVINST 5090.1B (Chapter 19) and 5100.19C.

For the purposes of the EIS, the shipboard solid waste stream consisted of three general types of solid waste: biodegradable wastes (paper, cardboard, food), non-biodegradable wastes (metal and glass), and plastics. These are the types of solid wastes that need to be addressed with respect to MARPOL Annex V compliance. The EIS did not address other ship waste streams such as sewage, and oily, medical, or hazardous wastes.

The EIS also did not address the issue of solid waste discharges from submarines because submarine characteristics and operations are significantly different from surface ships (e.g., they have unique submarine characteristics include critical space, weight, shock, acoustic, and atmospheric-control requirements and criteria). However, subsequent to the surface ship study the Navy developed several options for submarines by evaluating and addressing reduction, retention, and discharge of solid wastes. This was documented in another report to Congress in December 1997. The Navy determined the most appropriate solid waste management strategy for submarines, which is both operationally and environmentally sound, to be the retention of plastic waste on-board and the continued use of trash disposal units (TDUs). The environmental impacts of submarine discharges were addressed in separate NEPA documentation.

4.2 EIS Alternatives

Pursuant to NEPA and the regulations of the Council on Environmental Quality or CEQ, an EIS must consider a range of reasonable alternatives to a proposed action. One alternative that must always be considered in an EIS is the "no action" or "do nothing" alternative. That is, the EIS must consider the impacts of not implementing the proposed action. Thus the EIS addressed the no action alternative and shipboard solid waste alternatives in the Navy's Report to Congress, as follows:

- **No Action Alternative** - Under the no action alternative, the Navy would continue its current shipboard solid waste disposal practices, with various discharge restrictions depending on the ship's location. For example, for non plastic solid waste, the Navy operates under various restrictions depending on whether the ship is inside or outside of a MARPOL in-effect special area. In in-effect special areas food waste is not discharged less than 12 nm from land.
- **Store and Retrograde Alternative** - The store and retrograde alternative focuses on technologies that would permit the storage and retrograde of all non-food waste, either on board the generating ship or by service force ships. These included study of refrigeration, processing, compaction, odor barrier bags and other means to facilitate the storage and retrograde of solid waste for disposal on shore.
- **Process and Discharge Alternative** - Plastics processors would be used for surface ships and the plastic stored for retrograde; food wastes would be discharged overboard. The use of pulpers for processing paper and cardboard, and shredders for metal and glass, would be implemented. The processed material would then be discharged overboard.
- **On Board Destruction Alternative** - The on board destruction alternative focuses on technologies that would result in virtually complete destruction of waste aboard the vessel. The waste destruction technologies could include incineration or more technologically advanced thermal destruction, such as plasma arc pyrolysis. Under this alternative, the proper handling of any residue would mean its retention on board.
- **Special Areas Compliance Plan** - The Special Areas Compliance Plan, identified in the Navy's Report to Congress, is the Navy's preferred alternative for management of shipboard solid waste. In combination with plastics waste processors, the Navy would install pulpers and shredders on all vessels the size of frigates or larger (roughly 200 ships). These include such ships as frigates; destroyers; cruisers; amphibious helicopter assault ships; aircraft carriers; and fleet oilers and supply ships. The Navy would to retain and retrograde waste on smaller ships and patrol craft (roughly 55 ships). These include: mine countermeasure and mine hunting ships; rescue, salvage and towing ships; coastal patrol boats, and landing craft that have a limited range and mission duration.

5.0 EIS Study Findings

5.1 No Action Alternative

The impact of the no action alternative on the shipboard environment would continue to be severe with respect to quality of life, mission readiness, and damage control. Floating marine debris and beach litter would continue to be a problem. Finally, this alternative does not comply with APPS and does not contribute to the Navy's pollution prevention efforts.

5.2 Store and Retrograde Alternative

Although the store and retrograde alternative complies with APPS and makes a positive contribution to the Navy's pollution prevention efforts, implementation of the store and retrograde alternative for existing ships would adversely impact the shipboard environment by further reducing already cramped crew berthing and living

space to accommodate equipment and dedicated storage space. Additional Combat Logistics Force (CLF) ships would be required due to the amount of waste that would be retrograded. In addition, existing CLF ships would need to be physically modified, thereby removing some of their operational and living space. The store and retrograde alternative presents a number of logistical problems including increased frequency and duration of underway replenishments (UNREPs) and increased frequency and duration of port calls.

Costs to implement the store and retrograde alternative would be significant. The total costs to the fleet would be a minimum of \$1.0 billion. These costs do not reflect the reinstallation of displaced equipment and crew, which would be significant.

5.3 Process and Discharge Alternative

No significant shipboard impacts were projected to result from the installation of pulpers and shredders. Odor impacts from storing food-contaminated wastes would be eliminated or reduced. Prompt removal of all wastes would make storage of wastes in inappropriate spaces unnecessary; personal crew space would not be affected on any class of ship; and only in one instance would a portion of crew shared space be lost. This alternative would enhance mission readiness for Navy ships since waste disposal could proceed during flight operations. Flight decks, hangars, and other operations space would not be cluttered with the temporary storage of solid waste.

The pulpers would create a mixture of seawater and pulped paper/cardboard for overboard discharge. The discharged slurry is 0.3 to 0.5 percent solids by weight and consists mainly of cellulose. Studies showed an immediate 100,000:1 dilution when discharged into the wake of a ship. At concentrations expected after discharge, bioassays showed no detrimental effect in any marine organism studied. Shredders would create a sinkable bag of shredded glass and metal for overboard discharge. Studies showed that the bags sink rapidly, become partially buried on the bottom, will not move towards shore, and become colonized by various types of marine organisms. Over time, the shredded metal oxidizes and disintegrates.

The cost impacts of acquiring, installing, and operating the pulpers and shredders for the process and discharge alternative would be significantly lower than costs for the other equipment alternatives. The total cost for the fleet would be \$340 million.

The process and discharge alternative would be implemented outside of special areas, as well. The process and discharge alternative does not comply with APPS but does contribute to overall pollution prevention efforts.

5.4 Onboard Destruction Alternative

Significant shipboard impacts were identified for all ship classes. The space required for the installation of thermal destruction equipment would result in reduction in crew or troop berth space; this force reduction would in turn negatively impact the ship's mission capability. Mission readiness would also be impacted on all ships with flight operations, because of incinerator emissions. A modeling study of shipboard incinerator emission indicates that the air quality impacts from ship incineration would not be significant.

Implementation of the on-board destruction alternative would entail major cost impacts. The total costs to the fleet would be a minimum of \$1.2 billion. These costs do not reflect the reinstallation of displaced equipment and crew, which would be significant. The on-board destruction alternative would not be implemented outside of special areas. The on-board destruction alternative complies with APPS and, is also beneficial from a pollution prevention standpoint.

5.4 Compliance Plan

Under the Compliance Plan, the Navy would install paper/cardboard pulpers and metal/glass shredders on frigates and larger ships (roughly 200 ships). Small ships and coastal craft whose missions are of relatively short duration (roughly 55 ships) would store solid waste in odor-barrier bags until returning to shore or for transfer to another ship. Plastics waste processors would be installed on approximately 200 ships to manage plastics wastes. Thus, for larger ships, impacts of the compliance plan would be those described for the process and discharge alternative. For smaller and coastal vessels, mission readiness would be potentially reduced with storage of unprocessed solid waste, although this impact should not be significant given the fact that these ships operate close to shore and have more frequent off-loading opportunities.

6. Results

Congress concurred with the Navy's findings and proposed plan, as reflected in the National Defense Authorization Act for Fiscal Year 1997. This law included specific language allowing Navy ships that cannot comply with MARPOL Annex V to discharge the following solid wastes in the "special areas":

- Pulped paper, cardboard, and food waste that can pass through a screen with 12-mm openings (beyond 3 nm from land)
- Metal and glass that have been shredded and bagged to ensure negative buoyancy (beyond 12 nm).

The Navy was not provided with any relief from the MARPOL Annex V worldwide ban on the discharge of plastics (as implemented in APPS).

Pursuant to these laws, the Navy is installing plastics waste processors on frigates and larger ships to meet the December 31, 1998 legislative deadline. The Navy is also procuring pulpers and shredders for installation on these ships to meet the December 31, 2000 legislative deadline. Although not required to by law, the Navy has committed to operating its new shipboard solid waste pulpers and shredders everywhere, not just in the MARPOL "special areas." This will result in benefits to the marine environment that exceed the MARPOL Annex V objectives.